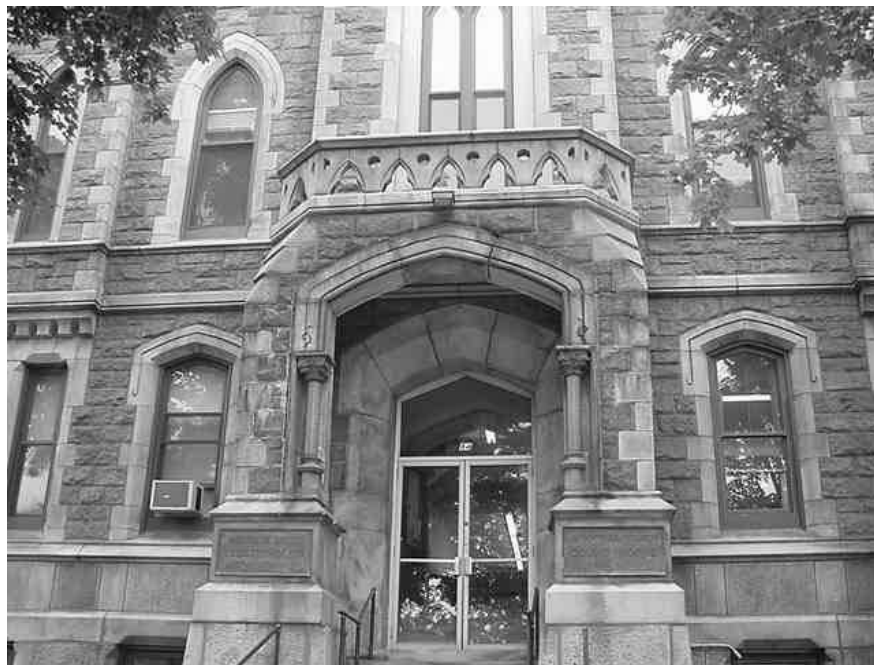


# **INDOOR AIR QUALITY ASSESSMENT**

**Fitchburg Superior Court,  
Fitchburg Law Library &  
Registry of Deeds Building  
84 Elm Street  
Fitchburg, Massachusetts**



Prepared by:  
Massachusetts Department of Public Health  
Bureau of Environmental Health Assessment  
November, 2001

## **Background/Introduction**

At the request of building occupants, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality concerns at the Fitchburg Superior Court, Fitchburg Law Library & Registry of Deeds building (FLL building) at 84 Elm Street, Fitchburg, Massachusetts. On June 22, 2001, a visit was made to this office by Michael Feeney, Chief of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA to conduct an indoor air quality assessment. Concerns about mold as a result of flooding in the basement from a rainstorm on June 17, 2001 prompted the request.

The FLL is a two-story stone and cement building constructed in 1871 (see Picture 1). The second floor previously contained Fitchburg Superior Court, which has relocated. The second floor was vacant during the assessment. The first floor is occupied by offices of the Registry of Deeds (ROD) and the law library. The ground floor contains several ROD book stacks, offices and the Housing Court courtroom. Windows are openable throughout the building.

## **Methods**

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551. Moisture content in wall-to-wall carpeting in the housing court courtroom was measured using a Delmhorst, BD-2000 Model, Moisture Detector.

## **Results**

These offices have an employee population of approximately 15 and are used by more than 35 individuals on a daily basis. Tests were taken under normal operating conditions and results appear in Tables 1-2.

## **Discussion**

### **Ventilation**

It can be seen from the tables that carbon dioxide levels were above 800 parts per million of air (ppm) in eleven of twelve areas sampled, indicating inadequate air exchange. All areas assessed were not equipped with mechanical ventilation. Each room has a radiator beneath the window that provides heat. The sole source of fresh air is through openable windows. Each office is equipped with a window-mounted air conditioner (WMAC). Some WMACs have the capacity to introduce fresh air, however the majority of installed machines recycle indoor air only.

Offices do not have mechanical exhaust ventilation. With the lack of exhaust ventilation, pollutants that exist in the interior space can build up and remain inside the building and lead to indoor air quality complaints.

During summer months, ventilation is controlled by the use of openable windows. The building was configured in a manner to use cross-ventilation to provide comfort for building occupants. The building is equipped with windows on opposing exterior walls. In addition, the building has hinged windows located above the hallway doors. This hinged window (called a transom) enables occupants to close the hallway door while maintaining a pathway for airflow. This design allows for airflow to enter an open

window, pass through a room and subsequently pass through the open transom. Airflow then enters the hallway, passing through the opposing room's open transom, into the opposing room and finally exits the building on the leeward side (opposite the windward side) (see Figure 1). With all windows and transoms open, airflow can be maintained in a building regardless of wind direction. The system fails if the windows or transoms are closed (see Figure 2). The use of openable windows in the summer is not desirable with WMACs because of energy loss and the introduction of uncontrolled moisture, which can result in the generation of excess condensation in WMACs and on cool building surfaces. If WMACs are deactivated then cross ventilation can be used.

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air

(ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings were measured in a range of 70° F to 74° F, which were within the BEHA recommended comfort range. The BEHA recommends that indoor air temperatures be maintained in a range of 70° F to 78° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. Concerns about lack of control over heat in the computer mainframe room were reported to BEHA staff. The room contains the mainframe for the building inside a cabinet (see Picture 2). At the top of the cabinet are fans that expel air from the cabinet into the room (see Picture 3). These fans were deactivated during the assessment.

Relative humidity measurements ranged from 39 to 52 percent, which were within or very close to the BEHA recommended comfort range of 40 to 60 percent. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. The sensation of dryness and irritation is common in a low relative humidity environment.

### **Microbial/Moisture Concerns**

According to court staff, the ground floor was flooded by water entering through a side exterior door adjacent to the parking lot (see Picture 4), moistening wall-to-wall carpeting in the Housing Court courtroom. A contractor was called to remediate flood damage, which included drying out the carpet. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that carpeting be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If carpets are not dried within this time frame, mold growth may occur. Water-damaged carpeting cannot be adequately cleaned to remove mold growth. At the time of the assessment, a dehumidifier was operating in the Housing Court courtroom. Moisture measurements taken in random sections of the carpet detected no moisture. The remainder of the ground floor is bare cement floor and appeared to be free of moisture.

Several areas had water damaged ceiling plaster (see Picture 5). The source of water causing the damage appears to be moisture penetration through window frames and missing stone mortar (see Picture 6). Paint and porous materials moistened by penetrating water can serve as mold growth media, especially if wetted repeatedly.

### **Other Concerns**

Filters in WMACs had significant amounts of accumulated dust and debris and were not installed to cover the entire surface of cooling fins (see Picture 7). The purpose of filters is to remove particulate matter from air drawn into the units. Filters need to be cleaned on a regular basis in order to maximize the efficiency of the filter. If not cleaned regularly, the filter can become saturated with dust and become a source of aerosolized

particulates when the air conditioner is operating. In order to reduce particulate aerosolization, filters should be cleaned or changed in a manner consistent with the manufacturer's recommendation.

The southwest corner room of the Registry of Deeds contained a blueprint machine (see Picture 8). Blueprint machines use ammonia and can give off gas and irritating odors during use. This machinery does not appear to be in use. A large exhaust vent, presumably for use when the blueprint machine is operated, is installed over this machinery.

An abandoned sink is in the same area as the blueprint machine (see Picture 9). It is likely that this sink has a dry drain trap. If drain traps dry out, sewer gas can back up the drains and enter occupied areas. Sewer gas can create nuisance odors and be irritating to certain individuals.

## **Conclusions/Recommendations**

In view of the findings at the time of the visit, the following recommendations are made:

1. Ensure Housing Court courtroom carpeting is completely dried.
2. The building was designed to use windows to provide fresh air. In order to temper room temperature and provide fresh air, the opening of windows is recommended when WMACs are deactivated. Create cross ventilation as described in Figure 1.
3. Seal sink drain. If not practical, have office occupants or maintenance staff pour water into the drain every other day to maintain drain traps.

4. Clean or replace filters in WMACs in a manner consistent with the manufacturer's recommendations. In order to reduce airborne particulates, consider operating the WMACs on the "fan only" setting during cold weather. The operation of the WMACs without activating the air-cooling capacity of the equipment will both provide particulate removal and increase air circulation in office space.
5. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a HEPA filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
6. Use the exhaust vent when blueprint machine is operating.
7. Consideration should be given to pointing exterior stonework. Recaulking to window frames should also be considered.



## References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

BOCA. 1993. The BOCA National Mechanical Code-1993. 8<sup>th</sup> ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL. M-308.1

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R. 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

Figure 1

Cross Ventilation in a Building Using Open Windows and Transoms

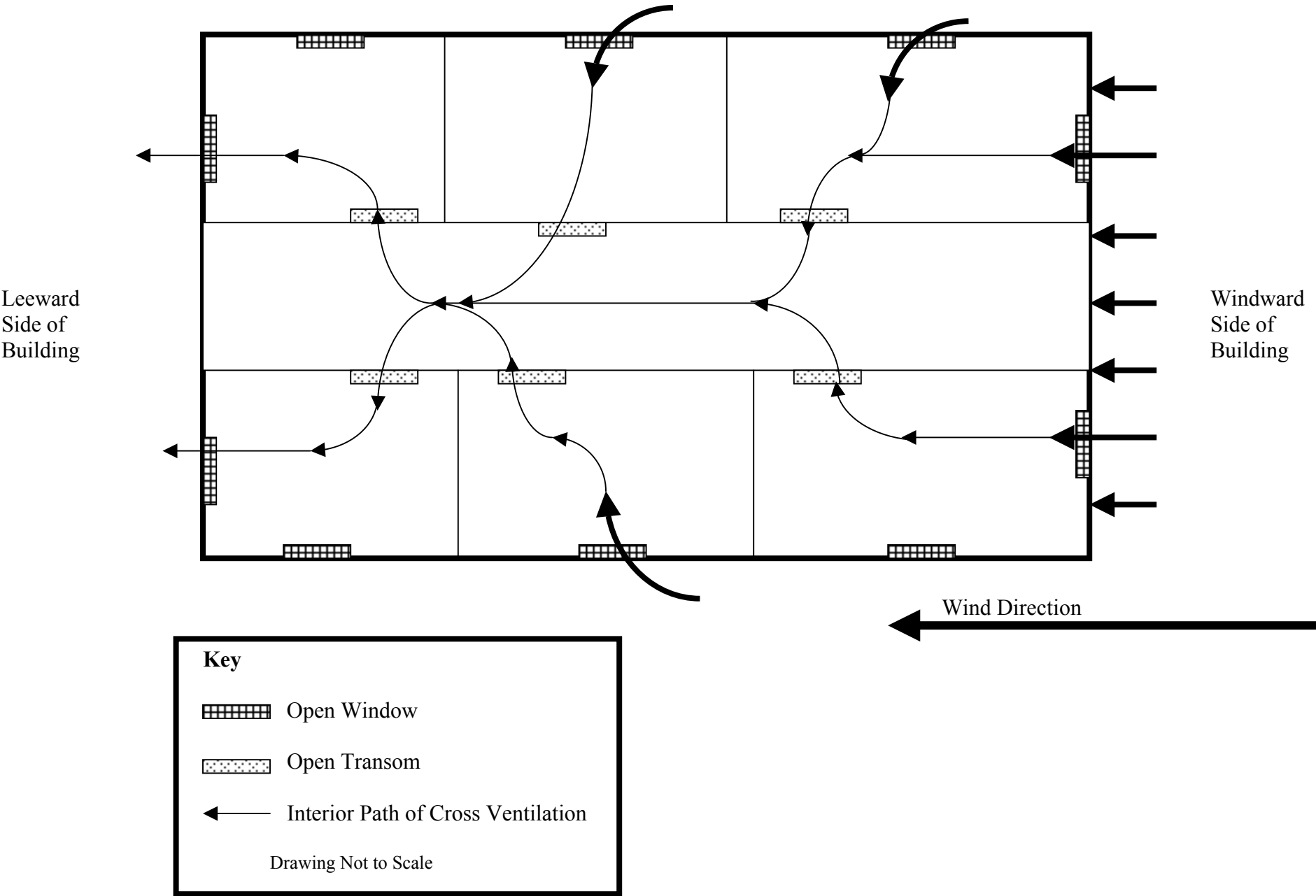
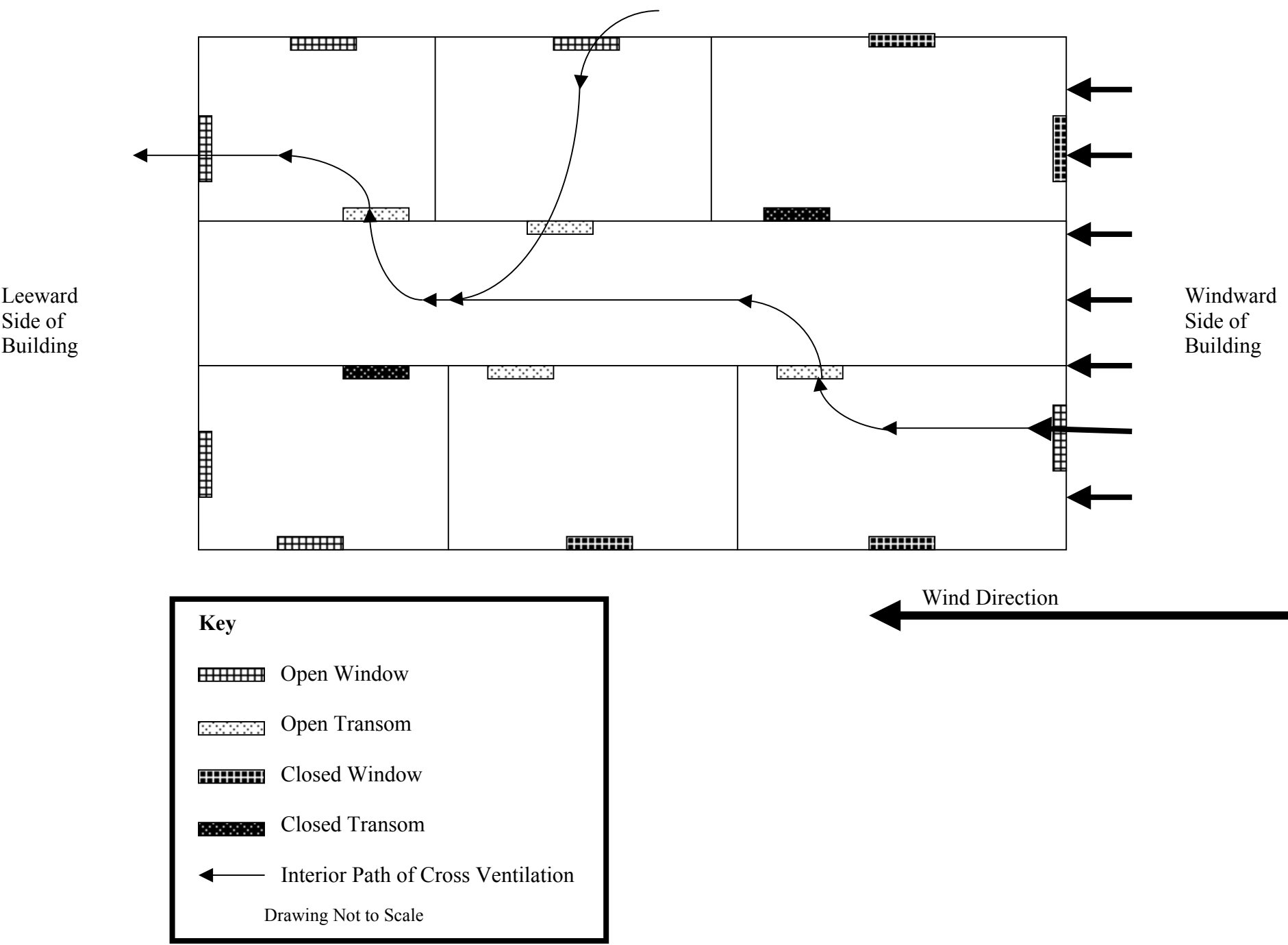


Figure 2

Inhibition of Cross Ventilation in a Building with Several Windows and Transoms Closed



**Picture 1**



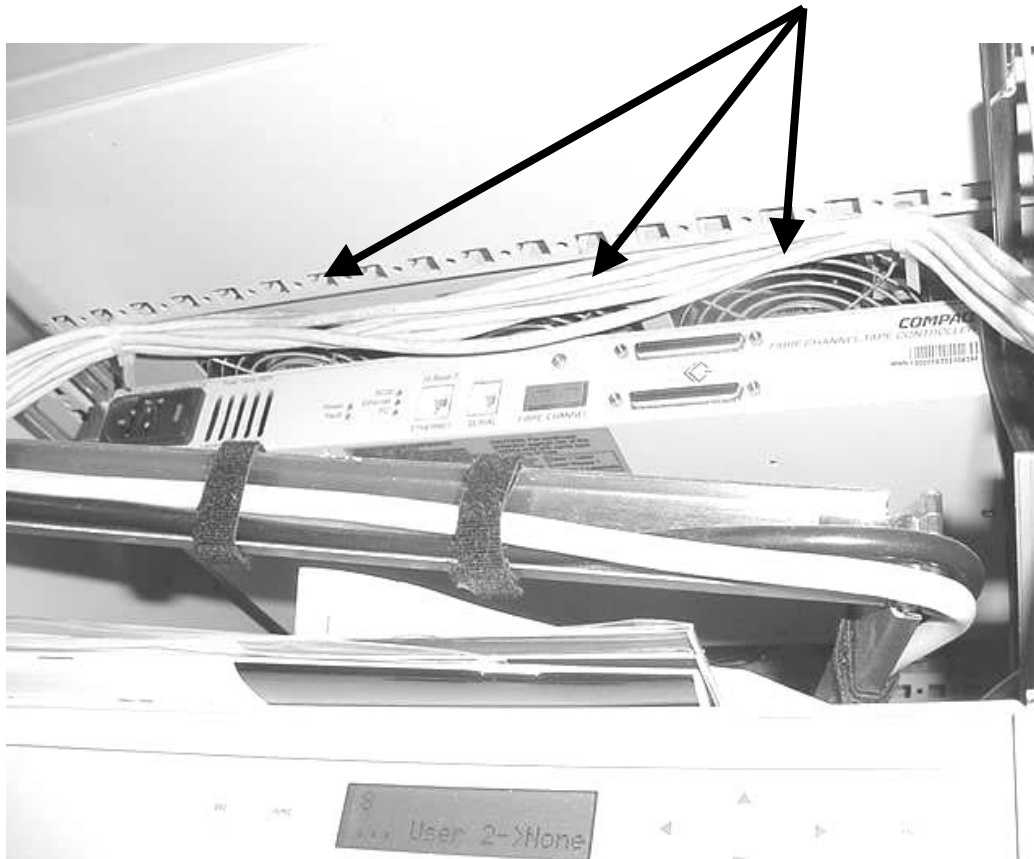
**FLL: Two-Story Stone and Cement Building Constructed in 1871**

**Picture 2**



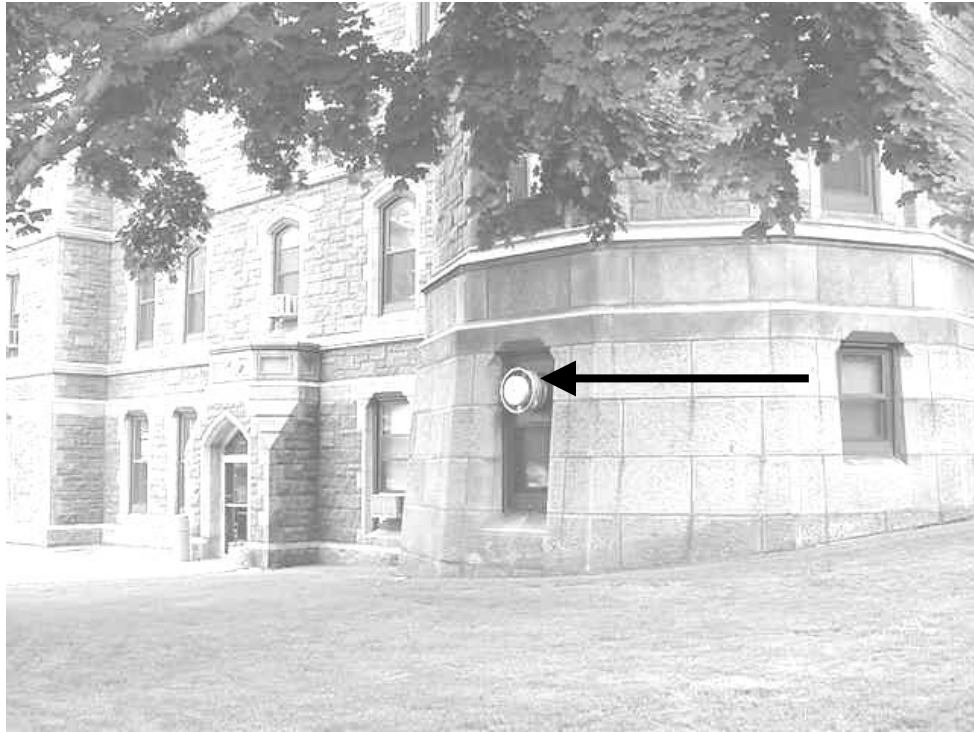
**Mainframe Computer Cabinet**

**Picture 3**



**Deactivated Fans of the Mainframe Cabinet**

**Picture 4**



**Side Exterior Door Adjacent to the Parking Lot, Note Exhaust Vent for Blueprint Machine**

**Picture 5**



**Water Damaged Ceiling Plaster, Covered With Plastic**

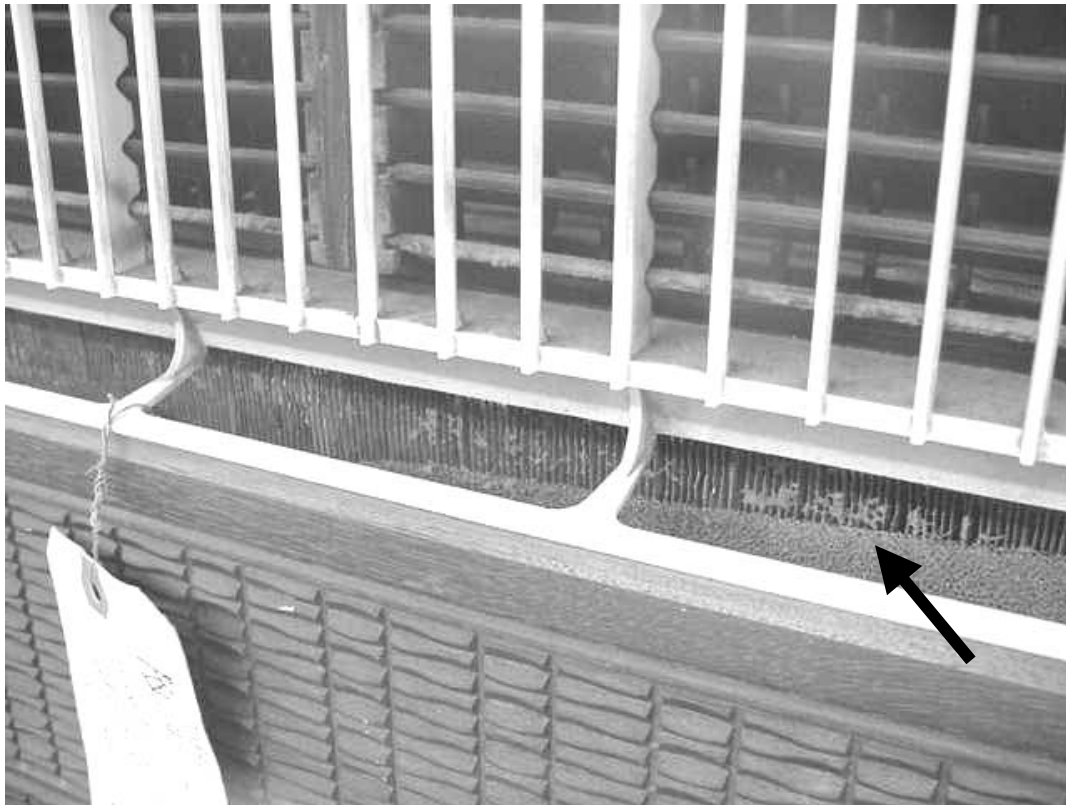


**Picture 6**



**Exterior Stonework**

**Picture 7**



**WAC With Improperly Installed Filter, Note Dust Accumulation on Coil Fins**

**Picture 8**



**Blueprint Machine**

**Picture 9**



**Abandoned Sink in the Same Area as the Blueprint Machine**

TABLE 1

**Indoor Air Test Results- Fitchburg Superior Court, Fitchburg Law Library & Registry of Deeds Building,  
84 Elm Street, Fitchburg, MA  
June 22, 2001**

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	506	74	61					
Worcester County Housing Court	660	70	43	0	Yes	Yes	Yes	Door open
Registry Of Deeds	1295	71	47	1	Yes	No	No	Window mounted air conditioner, door open
Registry Of Deeds - Front Desk	1347	72	46	3	Yes	No	No	Window gasket, window mounted air conditioner, water damaged plaster, door open
Registry Of Deeds - Library	1279	72	47	4	Yes	No	No	3 window mounted air conditioner, door open
Registry Of Deeds - Backroom	1296	74	47	0	Yes	No	No	Window mounted air conditioner-no filter
Registry Of Deeds - Verification	1053	74	44	0	Yes	No	No	Mainframe- heat into room, fans deactivated
Law Library Front	1157	74	43	2	Yes	Yes	Yes	2 window mounted air conditioner, window gasket, door open

\* ppm = parts per million parts of air  
CT = water-damaged ceiling tiles

**Comfort Guidelines**

Carbon Dioxide - < 600 ppm = preferred  
600 - 800 ppm = acceptable  
> 800 ppm = indicative of ventilation problems  
Temperature - 70 - 78 °F  
Relative Humidity - 40 - 60%

TABLE 2

**Indoor Air Test Results- Fitchburg Superior Court, Fitchburg Law Library & Registry of Deeds Building,  
84 Elm Street, Fitchburg, MA**

**June 22, 2001**

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Law Library Stacks	1043	72	34	0	Yes	Yes	Yes	Window mounted air conditioner, window gasket, water-cooler, door open
Registry Of Deeds - 1 <sup>st</sup> Stacks Se Room	930	71	45	1	Yes	No	No	Window mounted air conditioner, wall holes, door open
Registry Of Deeds - Sw Room	904	72	49	0	Yes	Yes	Yes	Sink- dry drain trap, blueprint machine, door open
Registry Of Deeds - Registered Land Office	941	73	52	0	Yes	Yes	Yes	Window mounted air conditioner, water damaged plaster, door open
Registry Of Deeds - Documents And Conservation	1001	74	51	2	Yes	No	No	Window mounted air conditioner, photocopier

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